Simultaneous determinations of U-Pb age and REE abundances for zircons using Laser Ablation-ICPMS

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Introduction

Laser ablation-ICP-MS (LA-ICP-MS) has been recently shown to be a potentially valuable alternative to U-Pb dating (Hirata and Nesbitt, 1995) and has the potential to detect sub-ppm level REE in situ. In this study, we have developed a new procedure for simultaneous determinations of U-Pb age and REE abundances from ~20 μm ablation pits of single zircon grains using ArF excimer LA-ICP-MS equipped with a chicane ion lens system.

Experimental

An ArF excimer laser ablation system provides stable and reproducible signal intensity with smaller elemental fractionation effect compared with a Nd-YAG wavelength. With the chicane ion lens applied to quadrupole based-ICP-MS instruments, higher elemental sensitivity (x4 for Pb and U) and lower background count (<5 cps for Pb and <2 cps for U) could be achieved.

Coupling of ArF excimer laser ablation system and the chicane ion lens system provided us much precise U-Pb age data and REE abundances on single ablation pit. The results of U-Pb age and REE abundances for Nancy 91500 standard zircon show good agreement with those for literature values [Wiedenbeck et al., 1995, Sano et al., 2001]. Fig.1 shows the U-Pb data obtained here for Nancy 91500 standard zircon with those obtained by the conventional Nd-YAG system, indicative of remarkable improvement in analytical precision. Details of the analytical technique and U-Pb age and REE abundances data for other samples will be discussed in this talk.

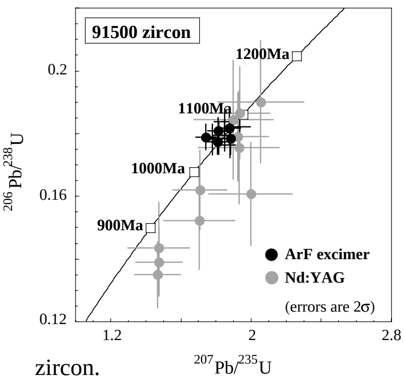

Figure 1: Concordia diagram for 91500 zircon.

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Geochemical characteristics of cretaceous collision-related plutonism in Turkey

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Turkey is one of the important segments of the Tethyan orogenic collage and it is the product of mainly two major collision zones. The more recent is the Eocene continent-Pontide arc collision after which large volumes of post-collisional magmas were erupted in eastern Anatolia. The earlier episode, subject of this study, is the Cretaceous continent-island arc collision. Here, the Central Anatolian Massif contains Paleozoic-Mesozoic metamorphic rocks overthrust by Upper Cretaceous ophiolitic units and intruded by a number of post-collisional plutons (about 79.5 to 66.6 Ma). The Massif exhibits good examples of calc-alkaline to alkaline magmatism of similar age in a collision-related tectonic setting. In the Massif, three different rock types have been recognised on the basis of their petrographical, mineralogical and geochemical characteristics: (i) calc-alkaline (Behrekdag, Cefalikdag, Celebi, Kösefakili); (ii) transitional (Baranadag); and (iii) alkaline (Hamit). The calc-alkaline and transitional rocks are metaluminous, I-type, ranging from monzodiorite through monzonite to granite. The alkaline rocks are alkaline-potassic, predominantly peralkaline and A-type ranging from monzosyenite through syenite to quartz syenite. All intrusive rocks exhibit enrichment in large ion lithophile elements (LILE) and light rare earth elements (LREE) relative to high field strength elements (HFSE) and have high $^{87}Sr/^{86}Sr$ (0.70804-0.70964) and low $^{143}Nd/^{144}Nd$ (0.512206-0.512303) ratios. These characteristics indicate a mantle lithospheric source region(s) carrying a subduction component inherited from a pre-collision subduction event. The Rb versus (Y+Nb) and the Th/Yb versus Ta/Yb diagrams show that the calc-alkaline, transitional and alkaline intrusive rocks have been affected by crustal assimilation combined with fractional crystallization (AFC) process. Coexistence of calc-alkaline and alkaline magmatism in the Massif has been attributed to mantle source heterogeneity pre-collision. Perturbation of metasomatized-lithosphere by either delamination of the thermal boundary layer or slab detachment is the likely mechanism for the initiation of the post-collison magmatism in the Central Anatolian Massif.